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XXVI.—*Report on* Mr. Ainsworth's *Observations on the Magnetic Intensity of the Earth, made during a Journey across the Continent of Europe in* 1838. By Major Edward Sabine, R.A.

Mr. Ainsworth has accompanied the manuscript record of his observations by the following description of the instruments with which they were made :—

" The observations of the dip were made with a needle $4\frac{5}{10}$ inches in length, with a steel axle, supported by agate cylinders. This instrument, which had previously accompanied the Euphrates expedition, was made by Robinson of London. At the time of observing, it was always adjusted to the magnetic meridian by the compass, and also by taking a position at right angles to the vertical position of the needle.

" The observations on the intensity of the horizontal force were made with two pair of cylindrical needles, vibrated in small arcs, commencing with 20°, in an apparatus similar to M. Hansteen's. In these observations every care was taken to prevent errors from difference of strength in the supporting fibre of silk, in the distance of the needle from the bottom of the box, and in the equipoise of the cylinder as well as the level of the box itself. One pair of these needles, E 1 and E 2, had been previously used in the Euphrates expedition. The other pair, A1 and A2, were made for the Kurdistán expedition, by Mr. Robinson, and brought to a steady, although with regard to one another, an unequal force, by immersion in boiling water. Successive experiments made on the same and on different days at Westbourn Green, near London, gave irregular results before this immersion; but the force at the same place became afterwards pretty constant at the same temperatures. The needles were $3\frac{3}{10}$ inches in length."

On the 9th of September Mr. Ainsworth, being then at Constantinople, and having completed his series of intensity results across the continent of Europe, enclosed needles E 1 and E 2 in a packet addressed to me, under cover to Captain Beaufort, Hydrographer to the Admiralty, for the purpose of having observations repeated with them in England, and compared with those made before his departure, in order to examine the steadiness of their magnetism in the interval. They reached me at Tortington, in Sussex, on the 18th of October, and were immediately examined as follow :—

		h. m.		Degr.		Seconds.
E 1,	Oct. 18,	1 40 P.M.	Therm.	53.5	100 vibr. in	559. 5
	Oct. 20,	1 50 P.M.		64.0	. . .	560.83
				58.75		560. 2

		h. m.		Degr.		Seconds.
E 2,	Oct. 18,	2 32 P.M.	Therm.	53	100 vibr. in	562.83
	Oct. 19,	4 40 P.M.		56	. . .	563.2
				54.5		563.0

Mr. Ainsworth's journal contains the following record of observations made with these needles at Westbourn Green, near London, before his departure from England:—

		h. m.		Degr.		Seconds.
E 1,	May 30,	4 28 P.M.	Therm.	67	100 vibr. in	559.5
	May 31,	10 15 A.M.		64.5	. . .	561.5
				65.75		560.5

		h. m.		Degr.		Seconds.
E 2,	May 30,	4 15 P.M.	Therm.	67	100 vibr. in	561.0
	May 31,	10 28 A.M.		64.5	. . .	567.5
	June 1,	10 40 A.M.		65	. . .	566.5
				65.5		565.0

From the well-ascertained difference in the horizontal intensity at the two stations, Tortington and Westbourn Green, these needles ought each to have made the time of performing 100 vibrations about 4 seconds *less* at Tortington than at Westbourn Green; whereas, when corrected for the difference of temperature, the times at Tortington are nearly the same as those in London. So far there is an indication of a slight loss of force sustained during their continental journey. It is, however, so slight,—not exceeding probably the fluctuations of the horizontal intensity itself at different seasons, and on different days,—or at least, not exceeding the limits of the differences which *these needles* have occasionally shown at the same place on different days,—that I have not thought any correction on this account called for.

Table 1 contains the times of vibration of the four needles at the stations observed at by Mr. Ainsworth. Table 2 contains the conclusions drawn from them. The values of the intensity are expressed in relation to the force at Paris, as Paris has been taken as a fundamental station by previous observers in the same parts of the European continent; and Mr. Ainsworth's results are thus brought into immediate comparison with theirs. His observations at Paris were made in M. Arago's magnetic cabinet, which is the usual place of observation there. In computing the horizontal intensities by E 1 and E 2, the times of vibration at the different stations have been corrected to a mean temperature, employing the co-efficient ·00038 found for E 1 in reducing the results obtained in the Euphrates expedition. As E 1 and E 2 were made of the same steel, are of the same dimensions, and have so nearly the same magnetic strength, the same co-efficient has been considered applicable to both. In the final results, which occupy the last column of Table 2, and exhibit the total intensities deduced from their horizontal components by means of the observed dips, the observations with E 1 and E 2 have been alone employed, as these needles are the only ones which have received the necessary verification of their unchanged rates. But the horizontal intensities computed by A 1 and A 2 are also given in separate columns, both distinctly and combined, for the purpose of comparison with those of E 1 and E 2. We may infer from the comparison that A 1 and A 2 both altered their magnetic state considerably between London and Paris; but as, when their results are combined, the difference of the force at those stations is the same by A 1 and A 2, as by E 1 and E 2 (·932 to 1.000), we may also conclude that what the one lost in force the other gained. This is, I believe, a very common circumstance with needles when first put together in pairs: they undergo more or less alteration, causing their respective forces to approximate; and this change takes place very shortly after they have been put together, their differences being subsequently pretty constant. Such appears to have been the case with needles A 1 and A 2, which, after Paris, present a tolerably uniform relation to each other. They have probably, on the whole, lost a little force: we may infer this from the general comparison of their results with those of E 1 and E 2: but they show a regularity which gives promise of their being very useful needles in the hands of so diligent and careful an observer as Mr. Ainsworth.

In the journal of the observations at Isella, in the pass of the Simplon, it is remarked that the dip instrument had been rudely examined by the Custom-house officers at the Sardinian frontier, and that the dips in the different positions of the instrument were not so accordant as previously. Mr. Ainsworth complains of this also in a letter from Constantinople; and the injury which the needle appears to have received at that time is traceable throughout the subsequent observations.

TABLE 1.

Station.	Date.	Time of 100 horizontal vibrations.				Therm	
		E 1.	E 2.	A 1.	A 2.		
	1838.						
London . .	May 29 June 7	560·5	565	367·25	385·5	66	Westbourn Green.
Paris . . .	June 20-21	541	546·5	357·75	369	68	Observatory.
Chalons . .	July 2	530·5	532	350·5	360·25	72	Near the Säone.
Geneva . .	July 10	522·5	525.5	346·75	358	74	Observatory.
Isella . . .	July 16	525	536·5	349·25	359	80	S. side of the Variola.
Milan . .	July 20	517.5	527	345	356·25	82	Botanic Garden.
Verona . .	July 23	515	524	not obsd.	not obsd.	74	Convent Garden.
Venice . .	July 26	510·5	517·5	341·5	351·5	71	Botanic Garden.
Ober Laybach	July 29	510	513·5	340·75	350·5	69	Inn Garden.
Vienna . .	Aug. 8	521	526·5	348·75	357·75	71	Bn. Hügel's Garden.
Pest . . .	Aug. 14	517	525	344·25	353·75	70	Summit of Blocksberg.
Galatz . .	Aug. 27-28	493·5	499	330·75	339·5	68	B. Consul's Garden.
Constantinople	Sept. 10	466·5	456·5	307·75	319·0	71	B. Ambassador's Garden.
Tortington .	Oct. 18-20	560·1	565·3	..	..	58	In a plantation.

TABLE 2.

Station.	Hor^{l}. Intensity. Paris = 1·000.				Means.		Observed Dip.		Total Intensity. Paris = 1·348 E 1 and 2.
	E 1.	E 2.	A 1.	A 2.	E 1. and 2.	A 1. and 2.	°	'	
London . .	·930	·934	·949	·916	·932	·932	69	24	1·362
Paris . . .	1·000	1·000	1·000	1·000	1·000	1·000	67	35	1·348
Chalons . .	1·043	1·042	1·042	1·049	1·043	1·045	65	25	1·289
Geneva . .	1·077	1·087	1·064	1·062	1·082	1·063	64	37	1·298
Isella . .	1·072	1·046	1·049	1·057	1·059	1·053	65	20	1.305
Milan . .	1·104	1·087	1·075	1·073	1·095	1·074	64	29	1·307
Verona . .	1·104	1·092	not obsd.	not obsd.	1·098	..	62	49	1·236
Venice . .	1·125	1·118	1·097	1·102	1·121	1·100	64	05	1·319
Ober Laybach	1·126	1·133	1·102	1·108	1·129	1·105	63	07	1·284
Vienna . .	1·080	1·079	1·052	1·064	1.080	1·058	64	16	1·280
Pest . . .	1·097	1·084	1·080	1·088	1·090	1·084	63	15	1·245
Galatz . .	1·202	1·200	1·170	1·181	1·201	1·176	61	15	1·284
Constantinople	1·348	..	1·351	1·338	1·348	1·345	56	34	1·258
Tortington .	·927	·925	..	..	·926	..	68	51	1·377

I have not drawn any result from the observations of E 2 at Constantinople. In every other instance the time of vibration of that needle is greater than that of E 1; but in this instance it is less. From this circumstance, and from the agreement of the results of E 1 with those of A 1 and A 2, it is probable that the observations with E 2 were on this occasion affected by some accidental irregularity.

I am able to supply the following comparisons of Mr. Ainsworth's results with those of other observers:—

Geneva,	Quetelet,	1830 .	1·292
	Ainsworth,	1838 .	1·298
Milan,	Humboldt,	1805 .	1·312
	Quetelet,	1830 .	1·294
	Ainsworth,	1838 .	1·307
Lohitsch,	Keilhau,	1826 .	1·314
Ober Laybach,	Ainsworth,	1838 .	1·284
Vienna,	Keilhau,	1826 .	1·325
	Ainsworth,	1838 .	1·280

The manuscript journal of Mr. Ainsworth's magnetic observations is deposited with the Geographical Society.

EDWARD SABINE.

Tortington, 23rd October, 1838.